

# System 18/30 Industrial Automation Computer System



GENERAL AUTOMATION, INC.<sup>®</sup>



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# INTRODUCTION

General Automation's fourth-generation computer technology enables industry to provide better products to more people at lower costs . . . through automation. Automation to GA means providing solutions for the complete spectrum of tasks required to automate a process. The result is increased efficiency, increased accuracy, and increased production . . . all at reduced costs.

## INCREASING PRODUCTIVITY WITH MANUFACTURING AUTOMATION

Applied to manufacturing systems, automation optimizes control of the various individual but interrelated phases of a production process. Through the computer, an automation system is able to acquire, evaluate, optimize, and control in an accurate and timely manner. In sensor-based real-time environments, information is acquired as it is created, control information is fed back within process time constant, and processing of data can be synchronous, asynchronous or periodic. Automation, then, increases the yield of better quality products and provides higher profits through reduced expenses.

General Automation's family of fourth-generation computer products now places total automation within the financial and technological bounds of an unlimited number of processes and industries.

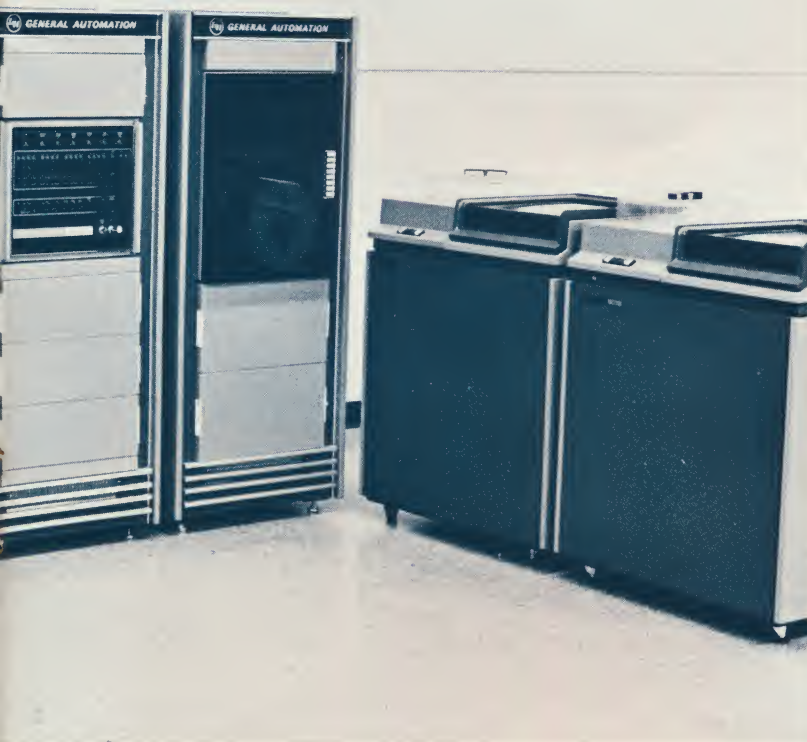






## SYSTEM 18/30—THE SUPERVISORY COMPUTER SYSTEM

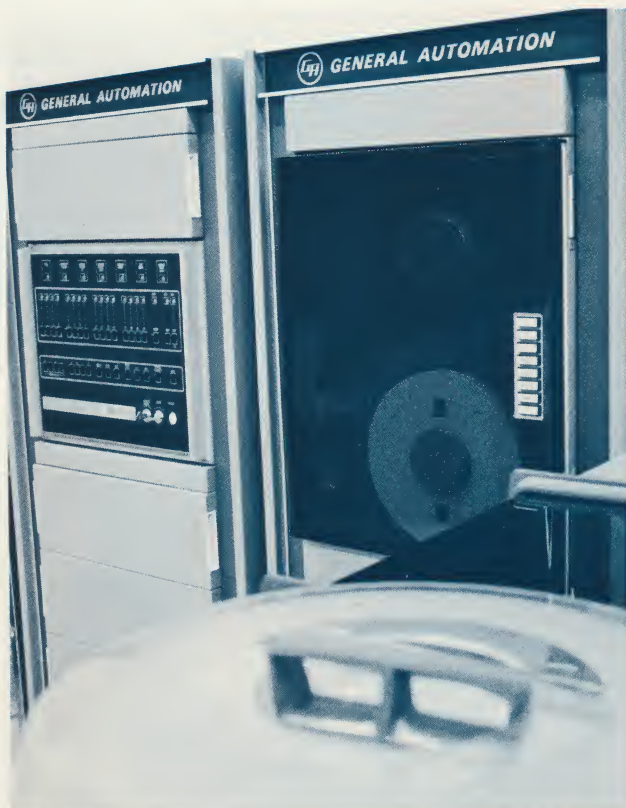
GA's System 18/30 Supervisory Computer has demonstrated top performance and highest reliability in a wide range of automation solutions in the "make-move-test-count" and control industrial environment. It is a large-capacity high-performance system for the real world of multiple priority levels. It will control a number of different manufacturing operations and processes, or supervise small computer systems such as GA's SPC-12 and SPC-16 worker level computers.



## THE FAST, POWERFUL 18/30 PROCESSOR

With its powerful computing capabilities, real-time safety features, and expandable I/O system, the System 18/30 is ideal for computer-based automation in real-time environments. Real time features include five automatic data channels, three interval timers, operations monitor, and automatic power shutdown and restart. Eight interrupt levels (internal, trace and six external) are provided as part of the priority interrupt feature. The external interrupts can be expanded to a maximum of 59 levels. The System 18/30 has a 16-bit word length plus parity and storage protection bits, single and double precision arithmetic, and hardware multiply/divide. The fast and powerful processor has a 960 nanosecond memory available in 4K increments to 32K. The instruction repertoire is compatible with both the IBM 1800 and 1130.





## GENERAL INFORMATION

### OPTIMIZING COMPUTER USE AND COST

General Automation's computers are part of the growing family of compatible products in the Distributed Computer Control. This concept (pioneered by General Automation) provides a more functional and efficient method of implementing manufacturing automation. It matches the size and capability of the computing system with the size and complexity of the application. Thus, each computer is priced commensurately with the level of work performed, offering maximum operating efficiency and profit returns with minimum expansion costs as well as minimum initial investment.

The most basic type of computer manufactured by General Automation is the *worker*, dedicated to one particular process. A single worker computer monitors a dozen or more production machines performing the same function. General Automation produces two worker level computers, the SPC-12 and the SPC-16, and one supervisory computer, the System 18/30.

**The SPC-12** is a low-cost, highly reliable 8-bit industrial control computer designed to function over a wide range of industrial environments in close proximity to the machinery and equipment it controls.

**The SPC-16** is a "super-performer" 16-bit industrial control computer that performs like two computers in one. It has the capability of performing a real-time dedicated control function, and at the same time performing background batch or data processing.

**The System 18/30**, the supervisor computer, is used to monitor and control a number of different manufacturing processes, via worker computers linked directly to the processes.

### SYSTEM FLEXIBILITY AND INTERFACING

Essential in applying General Automation's computers to their tasks are many Mini-controllers. Mini-controllers are GA system interface units that provide system modularity and interface versatility. Over 70 pre-engineered Mini-controllers are available off-the-shelf, providing system flexibility in interfacing with mechanisms, devices, instruments, sensors, and peripherals. Peripherals supplied by GA include printers, keyboards, teletypewriters, card/paper tape reader and punches, mag types, plotters, rotating memory and disk storages and data sets.



## OPERATING SYSTEMS AND SOFTWARE

General Automation 18/30 Operating Systems are a functional blending of the user's application requirements with GA hardware and GA software. By combining field-proven software with fast, powerful fourth-generation hardware, the user is provided with a General Automation computer-based automation system that gives him the best price/performance values in the industry. Because of their modular design, these operating systems are easily adapted to user requirements . . . large or small, simple or complex. They also feature simplicity of operation and flexibility for system growth. In addition to executive and operating systems, General Automation maintains a wide range of field-proven software.

## FULL RANGE OF AUTOMATION SERVICES

As the "total solution" automation company, GA supports its entire hardware/software product line with a full range of technological services for successfully implementing your automation project. GA's staff of experienced, highly qualified automation experts provide professional aid for any phase of project responsibility. These services include: Applications analysis and consultation, Systems engineering, Project documentation, Programming, User training and maintenance support.

## FOURTH GENERATION TECHNOLOGY AND RELIABILITY

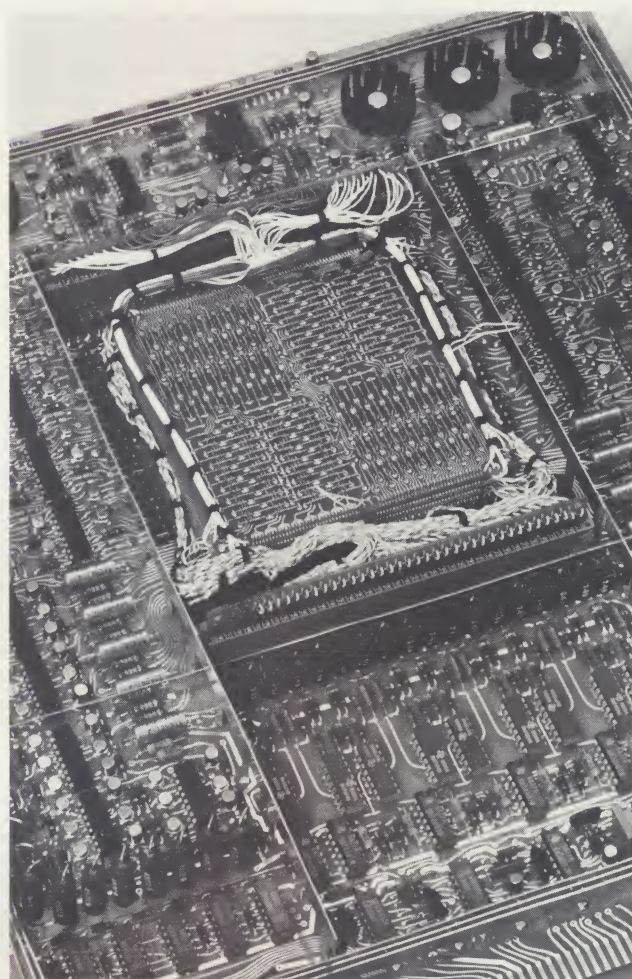
The high performance and long-life reliability of the System 18/30 are the result of GA's unique fourth-generation design, materials, manufacturing, and testing techniques. Fourth generation technology used in all GA computer products, begins at the critical design stage, is supported by fourth-generation construction techniques and built-in system safeguards, and is assured with exhaustive component/system testing and checkout. Such exhaustive testing eliminates defective components or those which have infant-mortality tendencies; this assures high-performance operation of the system in even worst-case noise/temperature environmental conditions.

## FAIL-SAFE FEATURES

The System 18/30 uses safety features to ensure reliable operation in the most demanding industrial environments. They guarantee high dependability for on-line control applications. The fail-safe features include Memory Parity, Memory Storage Protection, Operations Monitor Alarm, and Marginal Power Detection and Automatic Restart.

## MAINTAINABILITY

The System 18/30 is constructed for on-site replacement capability. Trained technicians, available from many locations throughout the U.S. and Europe, simply replace your board or memory in the field, send the original to the factory, then replace the temporary unit with the repaired module. The test and verify program supplied with System 18/30 pinpoints faults for quick troubleshooting, and margin test switches are included on every power supply.





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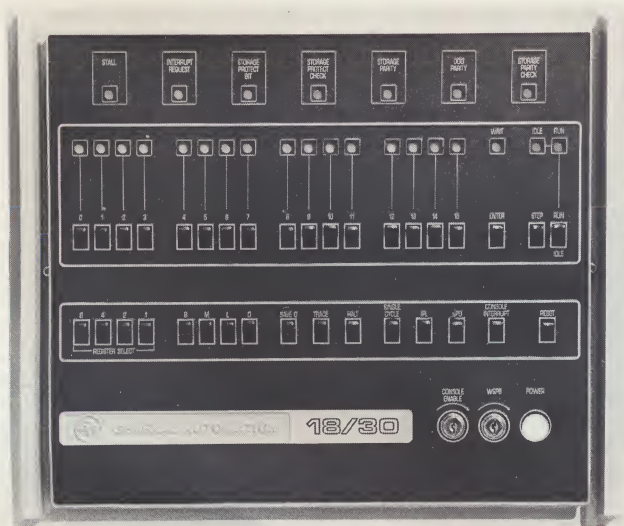
## SYSTEM 18/30 FEATURES

The System 18/30 consists of five modular sections (1) the 1804 processor (2) a family of communications equipment and dedicated terminals that provide remote data collection, processing, control, and display capability (3) a set of data processing peripherals to provide bulk storage, program generation, and data input/output data capacity (4) the process I/O section that contains the input/output devices required to connect the 18/30 system to industrial machinery, data collection devices, measuring instruments and sensors (5) and the computer-to-computer section that provides local connection to other computers in automatic management information and control systems. The modularity of the entire system permits matching the size of the system to the work to be performed with maximum economy.

The 1804 processor, heart of the System 18/30, is a medium scale industrial automation computer designed to function as part of an automatic control system. The organization and construction are designed to produce the highest level of reliability, system fail-safe operation, and best performance-versus-cost.

Fast and powerful, the System 18/30 has a 16 bit word length plus parity and storage protection bits, single and double precision arithmetic, and hardware multiply/divide. The processor has a 960 nanosecond memory available in 4K increments to 32K and a 16 word 35 nanosecond programmable register. Direct addressing to the entire 32K memory is provided. The System 18/30 will process over 400,000 instructions per second. While the instruction repertoire is fully compatible with both the IBM 1800 and 1130, the System 18/30 is equipped with an extra class of multi-purpose register-to-register commands. It also contains six external interrupts and six classes of instruction: Load and Store, Arithmetic, Shift, Branch, I/O and Processor/Scratch.

- **SPEED:** A fully parallel arithmetic unit featuring hardware multiply and divide, plus a 960-nanosecond memory, provides more computation in less time. Will process over 400,000 instructions per second.
- **POWERFUL INSTRUCTION REPERTOIRE:** The basic repertoire contains 32 instructions with numerous subsets. Both single and double-precision arithmetic instructions are standard. Most instructions can have single or double word formats.
- **IBM 1800/1130 INSTRUCTION COMPATIBLE:** Instruction compatibility with the IBM 1800 and 1130 at the binary level.
- **MULTIPLE ADDRESSING MODES:** Single word instructions can specify addressing relative to a base register (instruction counter or any one of three index registers). Double word instructions can specify direct, indexed or indirect addressing. Double word instructions can directly address 32K memory locations without the need for memory paging.
- **EXPANDABLE I/O SYSTEM:** The standard I/O system provides the capability for I/O control, sensing, and single word data transfer operations. Up to five direct memory data channels can be used for block-transfer capability. Eight interrupt levels (internal, trace, and six external levels) are provided as part of the priority interrupt feature. The external interrupts can be expanded to a maximum of 59 levels.
- **MEMORY EXPANSION:** The standard 4K word memory can be expanded to 32K words in blocks of 4K increments without the need for additional external enclosures.
- **RELIABILITY:** Worst case design features wire-free construction, integrated and all-silicon circuits, wide-temperature (lithium) memories, and exceptional speed, temperature, power and noise margins ensure reliable operation in the most demanding industrial environments.
- **SAFETY:** Memory write protection, stall alarm, and marginal power detection, and automatic restart features guarantee confidence for on-line control applications.





## SPECIFICATIONS

### TYPE:

Industrial-automation computer.  
Fixed word length, binary 16-bit plus parity, bit, and storage protect bit  
Parallel arithmetic

### CONSTRUCTION:

Integrated circuits  
Small scale integrated circuits (SSI)  
Medium scale integrated circuits (MSI)  
Wire-free, double-side printed circuit boards  
Printed circuit interconnect boards  
Ruggedized for industrial environments

### MEMORY:

Random Access  
8 memory sizes (4K to 32K in 4K increments)  
16 bit data word plus parity bit and storage protection bit  
Wide temperature ferrite magnetic cores  
Memory cycle time 960 nanosecond  
16 word MSI 35 nanosecond registers

### ARITHMETIC:

Parallel, 16-bit  
Binary, two's complement  
Fixed point  
Single and double precision  
Hardware multiply and divide  
Overflow and carry indicators may be program tested

### INSTRUCTIONS:

Six classes (over 400 modifications):  
Load and store (single and double word)  
Arithmetic and logical (single and double word)  
Shift  
Processor/scratch pad  
Branch and skip  
I/O  
Instruction repertoire compatible with IBM 1800 and 1130 to binary coding level.

### SPEED:

Add time (single precision)	2.4 $\mu$ s.
(double precision)	3.6 $\mu$ s.
Load and store (single precision)	2.4 $\mu$ s.
(double precision)	3.6 $\mu$ s.
Multiply	12.0 $\mu$ s.
Divide	13.2 $\mu$ s.
Branch	1.2 $\mu$ s.
I/O Transfers	3.6 $\mu$ s.
Data channel transfers	1.2 $\mu$ s.

### FAIL-SAFE:

Operations monitor (stall alarm)  
Automatic power fail shutdown and restart  
Memory parity bit and interrupt  
Storage write protect bit and interrupt and console key lock  
Console enable/disable key lock  
System reset signal  
System safe signal  
Wide temperature memories  
Industrial environment operation  
Wire-free construction

### INPUT/OUTPUT:

16-bit parallel I/O data bus  
Programmable parallel I/O data channel  
Programmable interrupts  
Up to 61 automatic priority interrupt levels  
Up to 976 system automatic priority interrupts  
Mask control on each interrupt level  
Five data channels (cycle stealing)  
Console data entry switch input via sense instruction

### DIMENSIONS:

19" x 15 $\frac{3}{4}$ " x 22 $\frac{1}{2}$ " Rack space with power supply and cooling

### WEIGHT:

85 to 105 lbs. (options selected) with power supply and cooling

### TEMPERATURE:

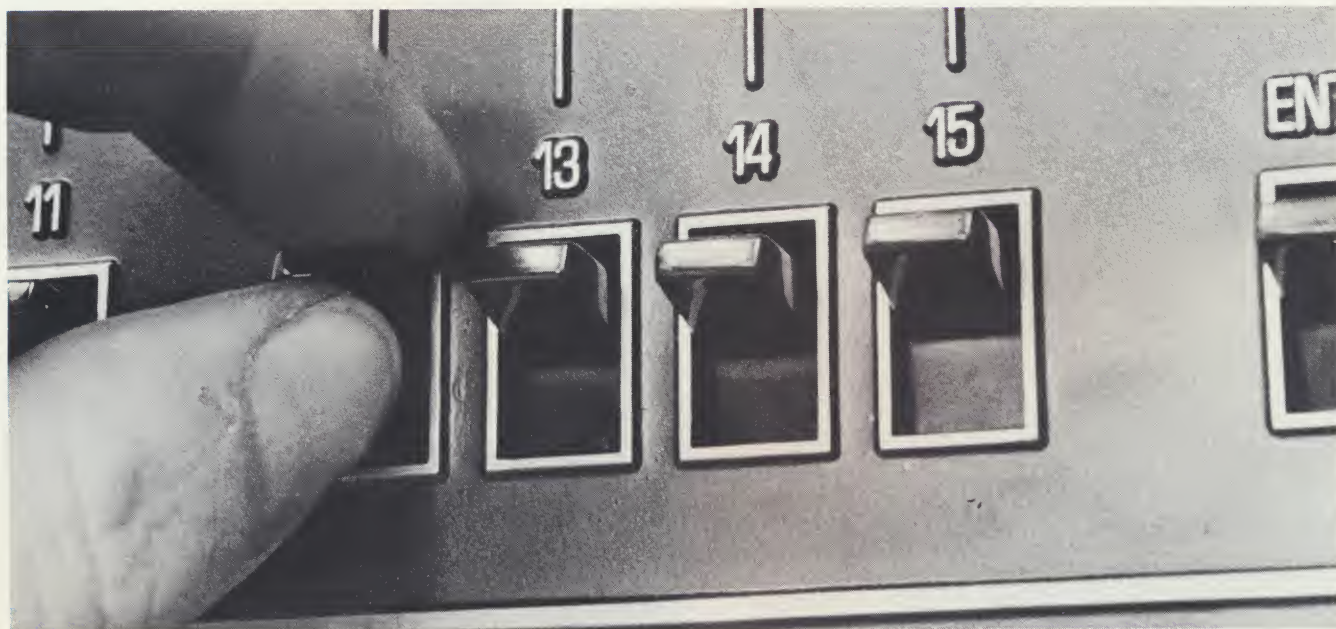
0 degrees Centigrade to 50 degrees Centigrade operable

### HUMIDITY:

To 90% relative  
(No condensation)

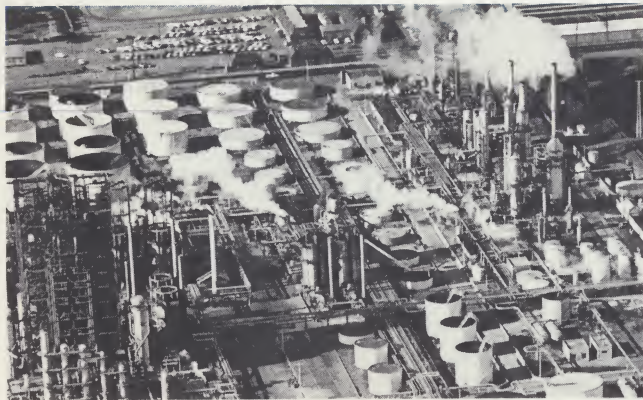
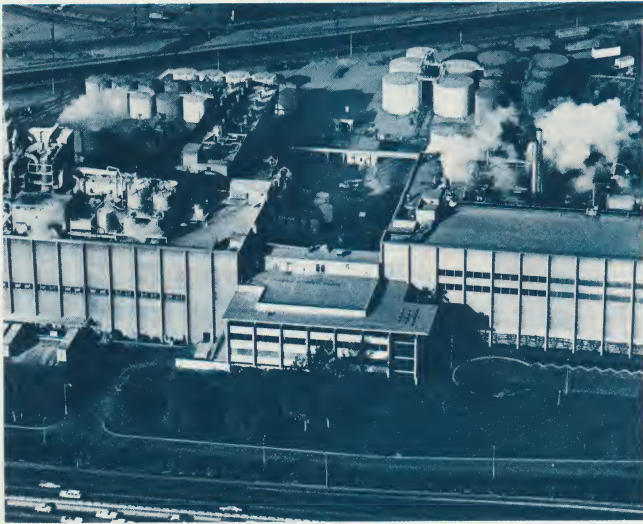
### POWER:

115 volts AC  $\pm$  10% single phase  
47 to 63 HZ  
or  
230 volts AC  $\pm$  10% single phase  
47 to 63 HZ





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## INDUSTRIAL APPLICATIONS

### MANUFACTURING

#### PRODUCTION MACHINES

Controls and monitors automatic and manually-operated production machines at a higher sustained efficiency rate. Monitors the actual piece-count production and machine status, and signals out-of-limit conditions as they occur. Enables corrective action to be taken immediately.

#### PACKAGE PROCESSING

Controls high speed packaging equipment and prevents inaccurate operation and breakdowns. Controls the speed of the filling device, the amount of product in the package to be filled, and weighs each package accurately.

#### SHOP FLOOR CONTROL DATA

Provides an economical data collection system for shop floor control validation of shipments, monitoring and testing of goods, and the staging of goods for production monitoring; monitoring of plant facilities; monitoring of the attendance, productivity, and the efficiency of production personnel; and direct dispatching of jobs in a predetermined priority sequence.

#### INDUSTRIAL TESTING SYSTEMS

Monitors and controls complex testing sequences in an industrial testing system. Operations include: product identification, selection of test sequence, calibration check of test equipment, automatic handling of units during testing, source collection and analysis of test data, accept/reject determination of testing units and printout of test results.

### AUTOMOTIVE

#### INTERNAL COMBUSTION ENGINES

Acquires data recorded from sensors attached to the internal combustion engine. Measures water temperature, oil temperature, RPM speed, torque, oil pressure, exhaust temperature, manifold pressure, and timing.

#### AUTOMOTIVE EXHAUST EMISSION

Identifies vehicle for record purposes. Analyzes samples of exhaust gas components during the test cycle. Computes the concentration and/or volume of each monitored gaseous constituent and compiles a test record.

#### PRODUCTION TESTING

Provides on-line analysis of automotive carburetors in a high-volume production assembly line. Significantly reduces the test time required while providing a greater yield of better quality carburetors.

### RUBBER

#### RUBBER PRODUCTION

Controls in-process inventories and maximizes utilization of machine tools in the production of rubber products. Substantially reduces the time and personnel required to summarize and review the stripcharts of production activity and the manually produced shift-end reports.

### ELECTRONICS

#### PERIPHERAL TEST

Computer interfacing and multi-unit control of input/output peripherals for large-scale computer installation. I/O units include a line printer, card reader, card punch, and magnetic tapes.

#### COIL WINDING PRODUCTION

Control of automatic winding machines for the mass production of small coils for magnetic-latching reed switches. Eight winding patterns are stored in the computer's memory. All eight of the patterns can be run on up to 16 machines. Coils are wound on plastic inserts in a steel plate on an 8" by 8" matrix. Inserts extend from both plate surfaces and provide 64 winding cores on each side.

#### PC BOARD PRODUCTION

Used for the automatic development, formatting, and conversion of instruction programs for numerically controlled printed circuit board drilling machines. Complete patterns are stored in the computer memory to perform step-and-repeat operations accurately. Frequently repeated patterns for standard devices are entered into memory that will completely define all points in the pattern after only two points have been located by the operator.

#### ELECTRONIC TESTING

Tests each of electric/electronic component in a high volume production line. Execute tests at a predetermined maximum rate; variations in manual operator rates are eliminated.

#### TESTING AND ANALYSIS OF CIRCUITS

Controls circuit testing and analysis systems. Coordinates the testing operations, specifications, signals, and the test sequence at electronic speeds, including: continuity, impedance, test stimuli, and measurement of the circuit output.

### AEROSPACE

#### AIRCRAFT WING PRODUCTION

Controls and monitors automatic riveting machines for manufacturing aircraft wings. Riveting patterns are stored in the computer's memory to perform step-and-repeat operations accurately and quickly.

#### FATIGUE TESTING

Acquires, processes, and analyzes fatigue stress data for a variety of metals as well as bonded joined materials. Prints out data for corrective action, thereby preventing potential accidents and malfunction due to fatigue stress.



## INDUSTRIAL APPLICATIONS

### METALS AND WOODWORKING

#### STEELMAKING

Controls and operates steel furnaces, and produces the metal in exact accordance with preset specifications. Calculates oxygen requirements, alloy additions, and power requirements.

#### METAL ANALYSIS

Monitors and controls optical emission and X-ray spectrometers widely used in the metals industry for high-speed determination of the chemical composition of metal.

#### TENSILE TESTING

Provides quality control, production techniques evaluation, product classification, and customer certification. Calculates the product's strength and other characteristics, records and calculates vital material properties, measures and computes tensile strength.

#### TRANSFER LINE

Monitors and controls transfer lines producing high production parts, and consisting of many machining stations mechanically connected by work piece transfer mechanisms, and closely interlocked with electrical controls. Receives input from operator or sensors, then concurrently checks the operating condition of line-mounted controls, takes protective action when required, prints out a report of the malfunction, and generates production reports.



### MATERIALS HANDLING

#### AUTOMATED WAREHOUSING

Provides optimum space utilization, significant manpower savings, and high turnaround for material requests in an automated "high cube" vertical storage warehouse. Keeps track of numerous units of merchandise, and optimizes the movement of stacker cranes. Provides real-time inventory control and warehousing applications to be integrated into a plant-wide information system.

#### MATERIAL HANDLING SYSTEM

Controls complex material handling system including storage and retrieval equipment. Processes orders, prepares shipping documents and invoices, provides operator guidance, maintains accurate inventories, and provides direct control of transport facilities and stacker units.



### PAPER

#### PAPER MILL PRODUCTION

Regulates the average basis weight and moisture variables in each paper grade. Manipulates the steam flow valve, adjusts the stock valve to the regulated basis weight, monitors and/or controls total flow and digital filtering of instruments signals.



## DISPLAY SYSTEMS

### EXTERNAL

Monitors and controls scoreboard displays located in sports stadiums providing score information, animation displays, and audience messages. Stores repetitive messages and animation programs of all types.

### INTERNAL

Provides generation and control of architectural display, light, sound, and temperature effects of remote-site data from microphones and CCTV sets.

## COMMUNICATIONS

### SYNCHRONOUS DATA EXCHANGE

The synchronous exchange of information on medium to high speed data links involves multi-processor or multi-device complexes. Remote computers perform process control or data gathering distribution tasks, and provide the System 18/30 Computer with information and data for process and/or management decisions and commands.

### TELEMETRY DATA ACQUISITION

Monitors remotely the physical status of objects, animals, people, or the environment in space flights. Evaluates incoming data for relative importance and validity. Isolates useful data from "noise" and other spurious signals.

### BROADCASTING

Provides automatic timing-control of audio/visual processes for radio and television stationbreak advertising. Maintains time-of-day synchronization with the national networks.

### EDUCATION

Provides audio/visual control of the teacher's presentation and real-time data acquisition. Processes and tabulates student responses.

### TELEVISION

Provides real-time data acquisition and processing of audience-viewer responses in audience participation shows. Tabulates and prints out responses for "instant" results while still on the air.

## POWER

### SUBSTATION MONITORING AND CONTROL

Monitors and controls high voltage and extra high voltage substations from centralized dispatching offices.

### PLANT POWER SYSTEM

Assures proper distribution of available electricity, gas, or steam in utility systems. Monitors powerhouse facilities, schedules distribution of the energy, and produces operating distribution logs.

## LABORATORY/MEDICAL

### PHYSIOLOGICAL MONITORING

Monitors the patient's disorder, including his blood pressure, respiration, temperature, appearance, urine output, blood and fluid loss, fluid and electrolyte intake, blood chemistry, weight, and electrocardiogram.

### SPECTROMETER OPERATION

Provides the computational, functional, and communication capabilities for optimum use of a spectrometer used in industrial applications. This includes checking, sequencing, calculating percentage composition of each element, outputting results, and calculating inter-element effect.

### GAS CHROMATOGRAPHS

Accurately measures chromatograph signal output and controls instrument functions amenable to external control, such as temperature programming, column switching, etc.

### AMINO-ACID ANALYSIS

Controls instrumentation obtaining amino-acid analysis data. Evaluates, acquires, and processes data for meaningful information and displays information for laboratory personnel.

## CHEMICAL

### AMMONIA AND ETHYLENE PROCESSING

Identifies mechanical problems in large compressors used to manufacture ammonia, ethylene, etc. Monitors bearing temperatures, operation of clearance pockets, compressor speed, power consumption, vibration, discharge temperatures, pressures, suction flow, and gas compositions.

### PLASTICS

Acquires, processes and provides stress analysis for a wide range of plastic materials. Calculates the product's strength, records and calculates material properties, measures and computes elasticity and hardness.

### EXPLOSIVES

Provides data acquisition and analysis of explosive shock waves. Measures and calculates explosive force and duration.

### DYES

Monitors and controls the processing of dyes used in the textile industry. Provides accurate processing of color blending and matching to predetermined values.

## PETROLEUM

### GAS TRANSMISSION AND DISTRIBUTION

Monitors and controls pressures and flows of gas transmission and distribution systems. Data is gathered, measured in the field, and transmitted to the System 18/30.

### OIL FIELD

Provides on-site acquisition and processing of data received from drilling rigs on depth, density, etc.



## INDUSTRIAL APPLICATIONS

### TRANSPORTATION

#### RAILROAD

Counts and identifies railroad cars transporting materials and goods. Provides accurate weighing of each railroad car as it passes through the scale weighing system without stopping.

#### AUTOMOBILE

Provides centralized computer control of an electronic traffic control system. Records, analyzes and prints out traffic count and flow at various time periods, accident control and notification, control of traffic lights, etc.

#### AIRLINE

Monitors and displays airline flight arrivals and departures. Provides accurate up-to-date information on air flights to numerous air terminals and airline offices.

### COMMERCIAL

#### BANKING

Reads, analyzes and tabulates check data and monetary transactions in real time applications at branch offices. Central computer at the main bank processing center provides fast analyses and totals for management control

#### ACCOUNTING

Acquires, processes, and prints out man-hours on-the-job for job/function/time evaluation.

#### ENVIRONMENTAL CONTROL

Controls and monitors environmental conditions throughout a large office building. Evaluates and monitors temperature, humidity, pollen, air-borne dirt and irritants, etc., within the controlled environment.

### PRINTING

#### PRINTING PRESSES

Monitors and controls the operation of large multi-color printing presses. Preset ink fountain and compensator positions are maintained during running, taking into consideration temperature, humidity, ink absorption, etc.

#### TYPESETTING

Automation of formatting and typesetting in a high volume newspaper operation.

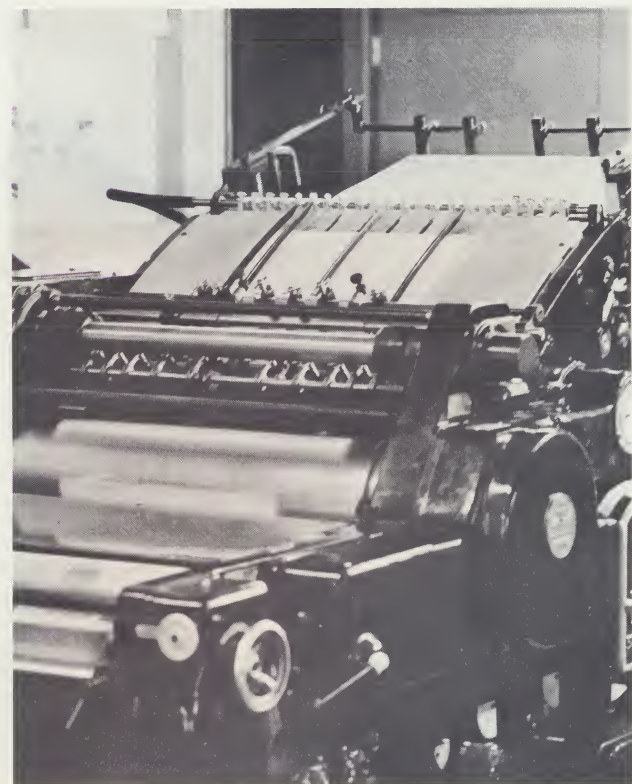
### RETAIL

#### MERCHANDISE

Automates checkstand operations in large retail stores. Computes transactions, for accounting and inventory control.

#### FOOD

Computes transactions quickly and accurately in a fast-food service. Maintains "instant" inventory control throughout the food chain's operation.





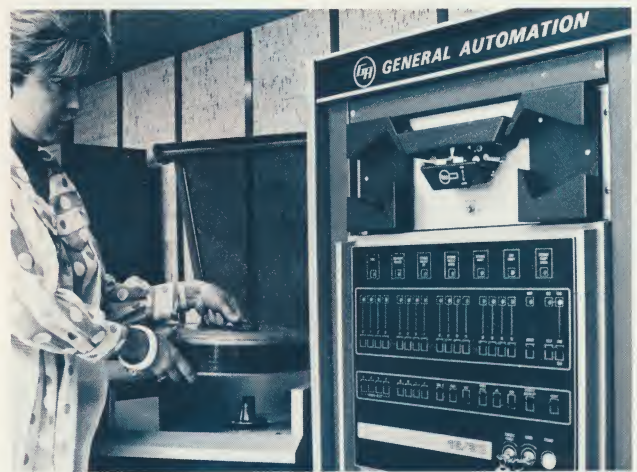
## 18/30 OPERATING SYSTEMS

General Automation 18/30 Operating Systems are a functional blending of the user's application requirements with GA hardware and GA software. These operating systems provide automation solutions in the "make-move-test-count" industrial environment... it's the real world of multiple priority levels. The versatility and performance of these systems make them especially suited for real-time sensor-based applications as well as for scientific, engineering, communications, and business activities. By combining field-proven software with fast, powerful fourth-generation hardware, the user is provided with a General Automation computer-based automation system that gives him the best price/performance values in the industry. Because of their modular design, these operating systems are easily adapted to user requirements... large or small, simple or complex. They also feature simplicity of operation and flexibility for system growth. They provide today's efficient operating system and form the basis for tomorrow's growing needs... all in a single economical package.

A unique and very specialized operating system, for example, is the 18/30-UNIAPT. It is an implementation of the popular APT, continuous path NC part programming language on the System 18/30 computer. It is compatible for all 3-axis and most 4-axis and 5-axis work. It provides parts programming turnaround in minutes instead of

days, and it is dedicated to your NC task at a price you can afford.

In addition to executive and operating systems, General Automation maintains a wide range of field-proven software for smaller or less sophisticated systems. They include application software packages, stand alone utilities, and program generation systems.



SYSTEM	MIN HARDWARE REQUIREMENTS	ADDITIONAL SUPPORTED HARDWARE
<b>REAL TIME OPERATING SYSTEM (RTOS)</b> Real-time foreground multiprogramming and background batch operating system.	16K Memory, Disk Card Reader or High-Speed Paper Tape Reader Teletypewriter (List and Punch)	High-Speed Paper Tape Punch Line Printer, Card Punch Process I/O, Plotter, Mag Tape CRT Uses logical I/O Structure, 16K
<b>REAL TIME EXECUTIVE (RTX-18)</b> Efficient real-time foreground multiprogramming executive.	4K Memory Card Reader or High-Speed Paper Tape Reader Teletypewriter (List and Punch)	High-Speed Paper Tape Punch Line Printer, Card Punch All Core Sizes, Drum and Disk Process I/O, Plotter, Mag Tape CRT
<b>BINARY SYNCHRONOUS COMMUNICATION SYSTEM (BSC)</b>	8K Memory	Double Buffered Controller
<b>DISK BASED OPERATING SYSTEM — (DBOS)</b> User-oriented batch operating system.	8K Memory, Disk Card Reader or High-Speed Paper Tape Reader Teletypewriter (List and Punch)	High-Speed Paper Tape Punch Line Printer, Card Punch, CRT Uses logical I/O Structure, 16K
<b>TIME-SHARED SUPERVISORY SYSTEM (TSS)</b> Real-time foreground/background operating system. IBM 1800 compatible.	16K Memory, Disk, Card Reader, Line Printer, Teletypewriter (List)	High-Speed Paper Tape Reader/Punch Card Punch 8K*, 16K, 24K*, 32K Mag Tape Process I/O, Plotter
<b>DISK MONITOR SYSTEM (DMS)</b> Disk-oriented batch processing.	8K Memory, Disk, Card Reader Teletypewriter (List)	Card Punch, Plotter, Line Printer, Paper Tape 8K, 16K and 32K, Mag Tape
<b>18/30-UNIAPT SYSTEM</b> Implementation of APT continuous-path NC part programming language.	16K Memory Mass Storage High-Speed Paper Tape Punch High-Speed Paper Tape Reader Card Reader Line Printer Teletypewriter	Plotter Card Punch Mag Tape Communications I/O Growth to DNC

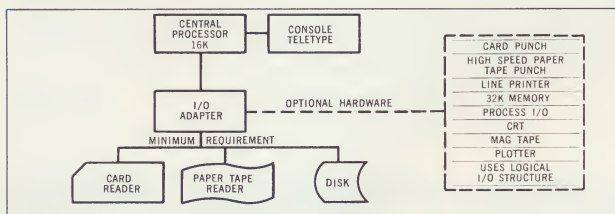
\*Special System



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## 18/30 OPERATING SYSTEMS

### REAL TIME OPERATING SYSTEM — RTOS



- A real-time foreground multiprogramming executive and a background batch operating system.
- Dynamic "Memory-Share" feature for interrupted data processing
- Up to 63 operating areas
- Schedules up to 255 programs
- Powerful program debugging aids including simulation and trace
- Fully FORTRAN compatible with extensive real-time subroutine library

The Real Time Operating System (RTOS) is a powerful, highly versatile system that combines the multiprogramming capabilities of the Real Time Executive (RTX-18) and the batching capabilities of the Disk Based Operating System (DBOS). The system is thus an efficient real-time executive capable of operating concurrently with a flexible user-oriented batch operating system. The modular construction of RTOS permits the user to select only those features which are required for his particular application, thus minimizing core and bulk memory requirements. RTOS has a maximum overhead of 3000 words of core for the foreground monitor. RTOS is fully operational in 16K processors.

#### PROGRAM GENERATION

**ASSEMBLER** — Generates object code for GA SPC-12 and SPC-16 processors as well as the System 18/30.

**FORTRAN COMPILER** — Generates 18/30 object code.

**CORE IMAGE CONVERTER** — A linking loader and core load builder. Up to four binary files are processed, two of which may be directoried.

**SOURCE FILE EDITOR** — Files may be accessed by index or text labels.

#### INPUT/OUTPUT SYSTEM

A device independent input/output structure forms the RTOS I/O system. Both foreground and background programs may reference devices logically. Physical device drivers may be referenced directly by foreground programs where the features of the logical I/O system are not required. Under this system a background program can connect, at run time, to any EDP peripheral and most disk files.

#### "MEMORY-SHARE" FEATURE

The operating core area assigned to the background system and selected foreground programs can be time-shared with the remaining foreground system. This allows those programs to be rolled-out to a bulk-save area if a higher priority foreground program requires the core area to operate.

#### LIBRARY OR FILE MAINTENANCE

Foreground and background programs have the capability to enter, delete, and modify programs and data files. Files can be generated in the background for processing by foreground programs or vice versa. Files are accessible in both foreground and background.

#### GENERAL UTILITIES

Routines are provided to change date, change time, lock out a foreground program, turn on a foreground program, add programs to the foreground task list.

#### PROGRAM EXECUTION

**BACKGROUND JOB PROCESSING** — Sequential job processing is provided under control of the background monitor.

**DEBUG UTILITY** — The Debug Program provides the following features: dump memory, display memory, change memory, exchange core and bulk memory, search file, move data and GO TO a background program.

**DEBUG EXECUTION** — TRAP programs may be executed under DEBUG using the TRAP features or under full Interpreter control.

**18/30 PROGRAM INTERPRETER** — An interpreter is provided to allow both foreground and background programs to be executed in a "debug" mode. The interpreter prevents "underbugged" programs from interfering with the foreground system.

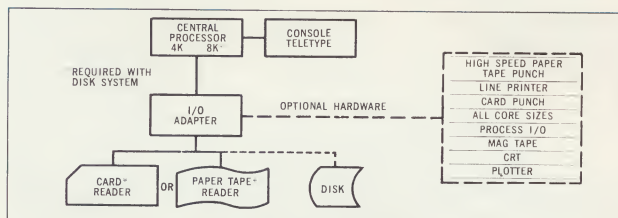
**SPC-16 SIMULATION** — Permits execution, trace and debug of SPC-16 programs in the background.

#### BINARY SYNCHRONOUS COMMUNICATION SYSTEM — BSC

GA's Binary Synchronous Communication System (BSC) provides the necessary line control discipline, data link utilization (station, polling, selection) and data protection procedures for the binary synchronous exchange of data on high speed communication links. BSC is implemented within the RTX-18 system. It has the capability to communicate on half-duplex two or four wire, point to point, multi-point, and 2000 to 4800 baud dedicated circuits.



## REAL TIME EXECUTIVE — RTX-18



- Extremely efficient real-time executive using approximately 2K words of memory
- Permits many real-time programs to be operational concurrently
- Permits tailored response times for real-time needs
- Higher Priority Interrupt System insures rapid response to emergency conditions
- Executes real-time commands of FORTRAN for faster, simpler and more economical programming solutions
- "Look ahead" capability determines device availability prior to data generation

RTX-18 is a small, extremely efficient and responsive real-time executive system designed to provide for monitoring and controlling all aspects of the operating environment. Central control is maintained through interrupt processing, program scheduling and input/output processing. The highly flexible multiprogramming executive requires less than 2,000 words of memory. Multiprogramming capabilities permit many real-time programs to be operational concurrently. The RTX-18 priority structure permits higher priority program to interrupt a running program and gain control. The use of in-line resident core, RTX interfaced resident core and disk resident program structures, permit tailored response times to meet the need of a real-time environment. Programs may be written for use with RTX-18 using either symbolic assembly language or FORTRAN.

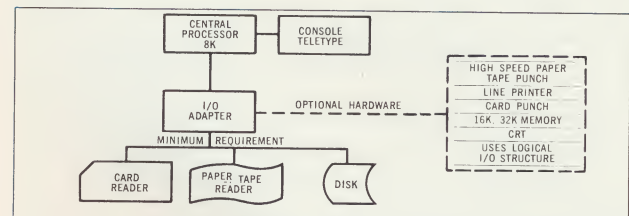
### SPECIAL FEATURES

Auxiliary timer counters may be used to monitor demand occurrence of timed programs. A periodic time base system is provided to permit execution of programs in synchronization with real time as well as cyclic delay systems. A system subroutine concept permits inclusion of core resident interruptable nonre-entrant programs as a part of RTX-18.

## BINARY SYNCHRONOUS COMMUNICATION SYSTEM — BSC

GA's Binary Synchronous Communication System (BSC) provides the necessary line control discipline, data link utilization (station, polling, selection) and data protection procedures for the binary synchronous exchange of data on high speed communication links.

## DISK BASED OPERATING SYSTEM — DBOS



- Provides efficient operations under monitor control with minimum manual intervention
- Provides simplified control sequences and an efficient file control system
- Device independent logical I/O
- Programmer-oriented aids for simpler operation
- Powerful program debugging aid

The Disk Based Operating System (DBOS) is a highly efficient and flexible user-oriented batch operating system. The system operation provides efficient operation under monitor control with simplified manual operations. It also substantially reduces job set-up time and operator errors. Simplified control sequences are provided with efficient file control. Job control is handled through the logical I/O system, with commands stored in any supported I/O device. DBOS employs a completely device-independent I/O structure.

### PROGRAM GENERATION

**ASSEMBLER** — Generates object code for GA SPC-12 and SPC-16 processors as well as the System 18/30.

**FORTRAN COMPILER** — Generates 18/30 object code.

**CORE IMAGE CONVERTER** — A linking loader and core load builder. Up to four binary files are processed, two of which may be directoried.

**SOURCE FILE EDITOR** — Files may be accessed by index or text labels.

### JOB PROCESSING

The JOB stream may consist of assembler, compiler, file maintenance, program checkout and program execution directives. The JOB processor assigns files, peripheral equipment and allocates memory during the processing of the JOB stream.

### LOGICAL I/O STRUCTURE

The Logical I/O structure permits the operator to select from several input and output devices for purposes of job processing at execution time.

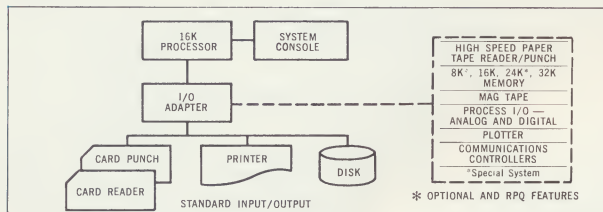
### RTX-18 GENERATION

Using the facilities of DBOS, the RTX-18 Executive can be configured and built in minimum time. Programs, executed under RTX, may be generated using DBOS.



## 18/30 OPERATING SYSTEMS

### TIME-SHARED SUPERVISORY SYSTEM — TSS



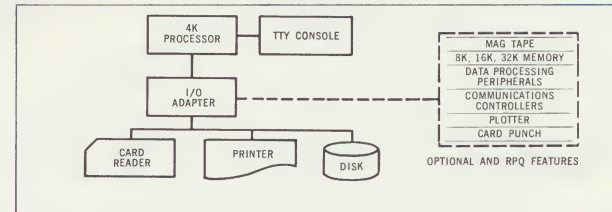
- An efficient, flexible foreground/background operating system
- Executives nonprocess programs (scientific processing, data analysis, etc.)
- Compatible — runs programs executable under the IBM 1800 TSX system
- Minimizes programming/reprogramming cost and set-up time for IBM 1800 users
- Easy to use . . . a simple replacement for IBM 1800 users.

General Automation's Time-Shared Supervisory System is a real-time programming system that provides the user with a convenient means of generating and using complete process control or data acquisition system programs. This powerful field-proven software provides for program supervision, time-keeping, interrupt processing, and peripheral device control.

The TSS is especially suited for "make-move-test-count" industrial automation applications such as machinery control, process control, materials handling, industrial testing, high-speed data acquisition, traffic control, and inventory maintenance. Off-line batch processing may be interleaved with on-line processing using user-written programs to monitor and control an operation or process. Programming may run on a scheduled or a demand basis.

The TSS also has the unique ability to run programs executable under the IBM 1800 TSX system on GA's System 18/30. This compatibility enables IBM 1800 users to move up to the speed and flexibility of the System 18/30 hardware with minimum reprogramming cost and set-up time. Using System 18/30 hardware, TSS users can achieve up to 10 times greater throughput capability with about half the cost of an equivalent TSX system.

### DISK MONITOR SYSTEM — DMS



- Compatible — runs programs executable under the IBM 1130 DM2 after local generation
- Provides greater system efficiency, flexibility and future expansion
- Easy to use . . . a simple replacement for IBM 1130 users
- "Roll-in/roll-out" feature for interrupted data processing to handle real-time situations
- Minimizes core storage requirements and permits segmenting of large programs

General Automation's Disk Monitor System (DMS) is a disk-oriented batch processing system for use on the GA System 18/30. Programs written for the IBM 1130 under DM2 are directly usable with an immediate increase in throughput, flexibility, and adaptability. With DMS the user has at his disposal powerful, field proven software for engineering/scientific applications as well as commercial applications. Using System 18/30 hardware, DMS users achieve at least twice the processing speed and 15 times greater throughput capability with about half the cost of equivalent systems. The standard DMS hardware configuration consists of high reliability components with very high speed capability. When the very high speed capability of the card reader (400 cpm) and the line printer (600 lpm) are combined with a seek time of ten milliseconds (65 milliseconds worst case) for the disk, a 15:1 increase in throughput over an IBM 1130 system is easily achieved. DMS facilitates the expansion of existing IBM installations.

ROLL-IN/ROLL-OUT capability is a special feature of DMS. Under operator control or in response to an interrupt, a program currently in execution can be rolled out to disk. The response program is then rolled in and executed. Upon completion of the response program, the interrupted program is restored and resumed. This feature makes possible interrupted data processing to handle real-time situations. Uses for this package are extensive, including rapid response to requests for data during long runs, direct data acquisition, online file modification and many others.



## 18/30-UNIAPT SYSTEM

### Full Apt Capability for NC Users at a New Low Cost

General Automation's 18/30-UNIAPT is an implementation of the popular APT, continuous path NC part programming language on the GA 18/30 computing system. No other tape preparation system can compare with the 18/30-UNIAPT: You get full APT capabilities at a fraction of the cost! You get a system that is compatible for 3, 4 and 5 axis work. You get a GA computer-fast system that gives you parts programming turnaround in minutes instead of days... thus greatly increasing the utilization of expensive NC metal working equipment.

### SYSTEM 18/30 COMPUTER

The large capacity 18/30 computing system can be expanded to handle many Direct Computer Control (DCC) Systems, and so supervise smaller "worker" computers used in DCC functions. It can monitor NC tool performance, connect with a variety of printers and plotters, and is compatible with CORDAX coordinate measuring devices.

### USES FIELD-PROVEN SOFTWARE

With each 18/30-UNIAPT System, a wide range of software is provided, including FORTRAN, Assembler, and other support programs. In addition, shop programs are available, such as post-processors, a shop accounting system, a shop scheduling system, and other useful packages.

### APT COMPATIBLE

For all 3, 4, and 5 axis work, the 18/30-UNIAPT System is compatible and interchangeable with APT. Not only will 18/30-UNIAPT programs run on APT Systems, but your existing APT programs will run on UNIAPT Systems with few or no modifications.

### REDUCES PROGRAMMING TURNAROUND

18/30-UNIAPT is dedicated to your NC task... you set the priorities. By placing the System at the immediate access of the part programmer, machine part programming turnaround times can be reduced to a matter of minutes.

### EASY TO LEARN AND EASY TO USE

18/30-UNIAPT handles simple point-to-point operations as efficiently as specialized systems designed for this purpose.

### OPERATES IN A SHOP ENVIRONMENT

It's rugged reliability enables the system to be placed in the part programming area or on the shop floor. Raised floors and special air conditioning are not required. It uses standard 110 volt, 30-amp power.

### SIMPLIFIED POSTPROCESSING

18/30-UNIAPT special compiler simplifies the postprocessing task. Postprocessors cost \$500 to \$1500 each.

## STAND ALONE SOFTWARE

General Automation maintains a wide range of field-proven software for smaller and less sophisticated systems. They include applications software packages, stand alone utilities, and program generation systems.

**SYMBOLIC ASSEMBLER** — The Assembler accepts symbolically coded input and translates it into machine language code. The input may be from punched paper tape or cards; output is punched paper tape or cards and printed listing. The 18/30 Assembler is compatible with the IBM 1130/1800 card paper tape assembler.

**FORTRAN COMPILER** — FORTRAN IV is a language designed primarily for engineering and scientific computations.

**GENERALIZED UTILITY SYSTEM** — The General Utility System (GUS) provides for operator control of the computer during debug activities.

**TEST AND VERIFY PROGRAMS** — A complete line of Test and Verify routines are provided to support all standard hardware.

**CORE IMAGE CONVERTER** — The Core Image Converter (CIC) constructs complete programs from mainlines generated by the FORTRAN compiler and the Assembler.

**SUBROUTINE LIBRARY** — The Subroutine Library is a collection of comprehensive subroutines to aid in the efficient use of the 18/30 computing system.

### FOR NON-DISK SYSTEMS

SOFTWARE	MINIMUM HARDWARE REQUIREMENTS	ADDITIONAL SUPPORTED HARDWARE
<b>GENERALIZED UTILITIES SYSTEM (GUS)</b>	4K Memory Teletypewriter	8K, 16K and 32K High-Speed Paper Tape Reader/Punch Line Printer
<b>ASSEMBLERS</b> ASM 1	4K Memory Card Reader Line Printer High-Speed Paper Tape Reader	
ASM 2	4K Memory High-Speed Paper Tape Reader/Punch Teletypewriter (List)	All Core Sizes
ASM 3	4K Memory Card Reader Card Punch Line Printer	
<b>FORTRAN COMPILER</b>	8K Memory Card Reader Teletypewriter (List and Punch)	High-Speed Paper Tape Reader/Punch Line Printer 8K, 16K and 32K
<b>CORE IMAGE CONVERTER</b>	8K Memory High-Speed Paper Tape Reader Teletypewriter (List and Punch)	High-Speed Paper Tape Reader/Punch Line Printer Card Reader Card Punch
<b>SUBROUTINE LIBRARY</b>		Standard I/O
<b>RTX SUBROUTINE Library Extensions</b>		Minicontroller Process I/O (Disk under RTX)
<b>1130 LOADER/EXEC. PKG.</b> (Permits loading and execution of programs generated on an IBM 1130 using a basic 18/30)	4K Memory Teletypewriter	All Core Sizes



# 16

## PROCESSOR ORGANIZATION

### ADDRESSING

The System 18/30 features a powerful addressing system and combines four addressing modes with six instruction classes. The four addressing modes are: (1) Direct Addressing, (2) Base-relative Addressing, (3) Indexed Addressing, and (4) Indirect Addressing. Single word instructions can specify addressing relative to a base register (instruction counter or any one of three index registers). Double word instructions can specify direct, indexed or indirect addressing. Double word instructions can directly address 32K memory locations without memory paging.

### PROCESSOR I/O

The System 18/30 features an expandable I/O system. The standard I/O system provides capability for I/O control, sensing and single word data transfer operations. Five direct memory data channels can be used for block-transfer of data directly between memory and I/O devices with a minimum of program intervention and with block chaining capability. All five channels can be set up to operate concurrently. The direct memory data channels operate directly with memory on a cycle-steal basis.

The interrupt feature of the computer permits the normal program sequence to be interrupted in response to a variety of internal or external stimuli that require special or immediate attention. Eight interrupt levels (internal, trace and six external levels) are provided as part of the priority interrupt feature. The external interrupts can be expanded to a maximum of 59 levels. When more than one interrupt request line is connected to an interrupt level, the individual request or requests causing the interrupt level to be activated must be identified by program. All external interrupts levels can be masked, unmasked and triggered under program control.

### INSTRUCTION REPERTOIRE

The System 18/30's extensive and powerful instruction set effectively handles single and double precision words, thus reducing programming and execution time as well as memory requirements for real-time applications. It is the most widely used 16-bit instruction set in the industry. The basic repertoire contains 32 instructions with numerous subsets. Both single and double precision arithmetic instructions can have single or double word formats allowing direct addressing to the entire 32K memory locations.

The basic instruction classes are:

- Load and store
- Arithmetic
- Shift
- Branch
- I/O
- Register transfer

The System 18/30 instruction set is compatible at the binary level with the IBM 1800 and 1130 computers. This compatibility allows the user to take advantage of the vast amount of software developed for IBM machines. In addition, the System 18/30 also has a set of register transfer commands that allow operands to be transferred and manipulated throughout the processor without the necessity of memory access. This provides greatly increased performance and more efficient instruction execution.

The following set of instructions offer over 400 combinations. This adds to the power and flexibility of the system without sacrificing ease of programming.

Mnemonic	Name
LDS	Load Status
STS	Store Status
LTX	Load Index
SDX	Store Index
LD	Load Accumulator
LDD	Load Double
STO	Store Accumulator
STD	Store Double
A	Add
AD	Add Double
S	Subtract
SD	Subtract Double
M	Multiply
D	Divide
AND	Logical And
OR	Logical Or
EOR	Logical Exclusive Or
SLA	Shift Left Logical A
SLCA	Shift Left and Count A
SLT	Shift Left Logical A and Q
SLC	Shift Left and Count A and Q
SRA	Shift Right Logical A
SRT	Shift Right A and Q
RTE	Rotate Right A and Q
BSI	Branch and Store Instruction Register
BSC (BOSC)	Branch or Skip on Condition
MDX	Modify Index and Skip
CMP	Compare
DCM	Compare Double
WAIT	Wait
XIO	Execute I/O
NOP	No Operation
RTR	Register Transfer
RCP	Register Transfer and Complement
RIC	Register Transfer and Increment
RDC	Register Transfer and Decrement



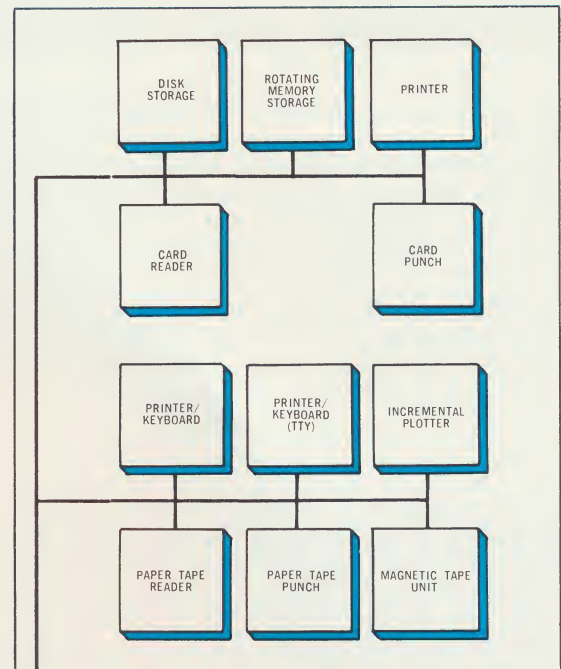
## SYSTEM SUMMARY

The System 18/30 has a flexible and versatile I/O system. It is readily adaptable to the process environment using standard interfaces. These pre-engineered interface units, called Mini-Controllers, will control instruments, sensors, mechanisms, and a wide range of devices. Their functional, plug-in design provides system modularity and interface versatility, eliminates redundant electronics, and permits quick, economical system configuring, expansion, and servicing.

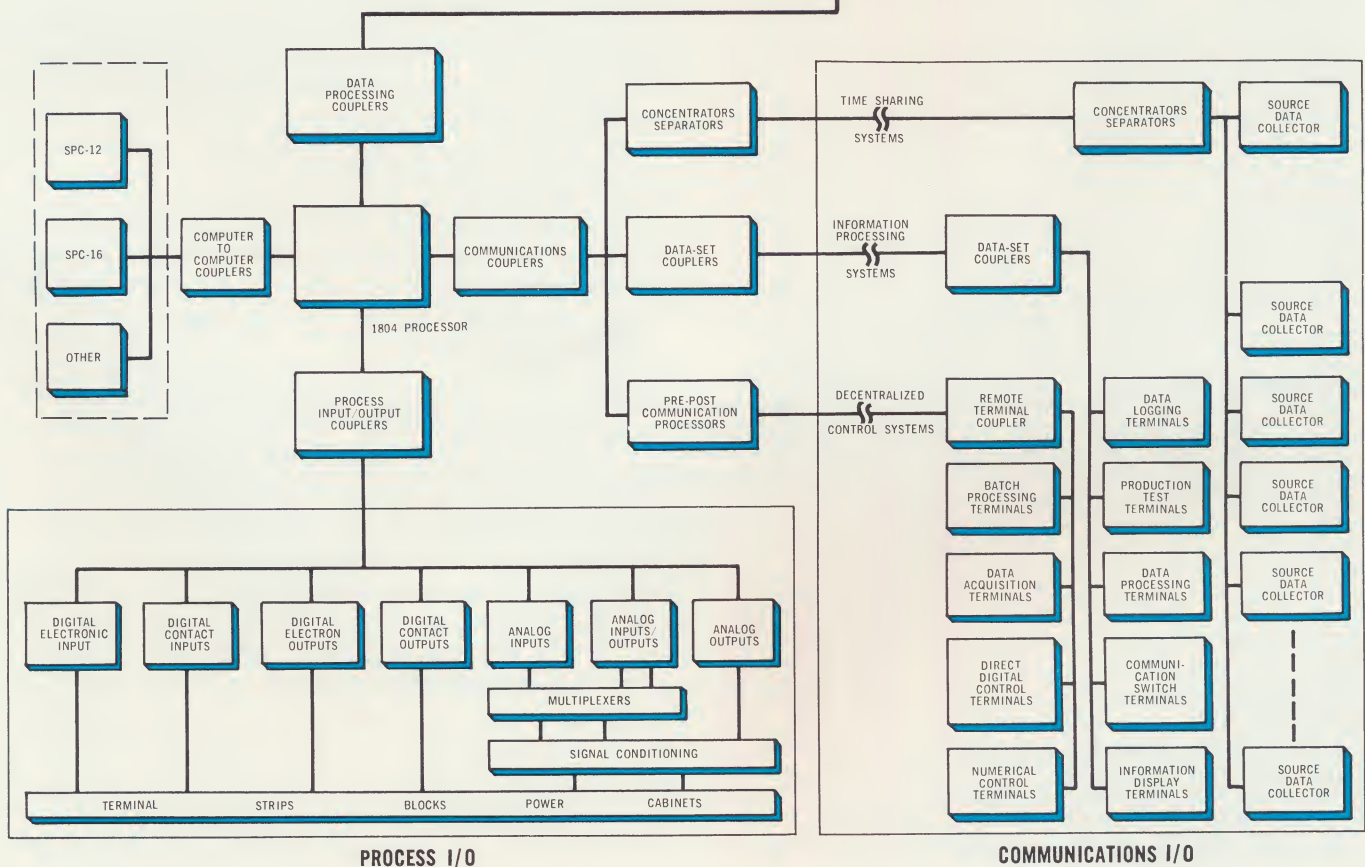
The System 18/30 has a powerful communications I/O system and will interface with a variety of data transmission devices. The communications I/O system will operate in a synchronous or asynchronous mode, half or full duplex, and a variety of data rates.

Also available are a variety of compatible peripherals. By providing compatibility with existing customer devices, system design time and implementation costs are substantially reduced.

In its place in the hierarchy of Distributed Computer Control, the System 18/30 will communicate with the SPC-16, SPC-12 and other computers, both directly and via communications lines.



DATA PROCESSING I/O



PROCESS I/O

COMMUNICATIONS I/O



## PROCESS AND COMMUNICATIONS I/O

Pre-engineered GA system interface units enable multiple technologies to be combined in one computer subsystem. More than 70 off-the-shelf mini-controller units are available for interfacing to and controlling instruments, sensors, mechanisms, devices, communication data sets, displays, keyboards, and a wide range of GA peripherals. By providing compatibility with existing customer device designs, design time and costs for implementation are substantially reduced. Field-proven integrated circuits throughout the advance-state design provide extremely high reliability.



### ANALOG I/O

The Analog I/O System enables the 18/30 to communicate with analog devices, and to perform both digital-to-analog and analog-to-digital conversions. This capability enables the 18/30 to be readily interfaced to such devices as thermocouples, strain gauges, pressure transducers, potentiometers, and other analog input devices. It will also drive system control functions, recording devices, and other systems elements requiring analog outputs.

#### 1441 ANALOG I/O UNIT (AIO)

The 1441 Analog I/O performs both analog-to-digital and digital-to-analog conversions. It is used with the 1451, 1452, and 1453 Analog Input Multiplexers and the 1481 Analog Output Holding Amplifier

#### 1451 HIGH LEVEL SINGLE-ENDED INPUT MULTIPLEXER (SEM)

The 1451 can interface sixteen channels of bipolar  $\pm 5$  volt analog input with the 1441 analog I/O unit. It provides multiplexing input capability for single-ended analog signals and is suited for applications where ground potentials are small with respect to the signal voltages.

#### 1452 HIGH-LEVEL DIFFERENTIAL INPUT MULTIPLEXER (HLM)

The 1452 provides analog input capability for 8 channels to the 1441 Analog I/O unit. Input signal range is  $\pm 5$  volts for applications where a significant common mode voltage is present.

#### 1453 LOW-LEVEL DIFFERENTIAL INPUT MULTIPLEXER (LLM)

The 1453 provides analog input capability for 8 channels to the 1441 Analog I/O unit. Input signal range is  $\pm 200$  millivolts for use in applications where a significant common mode voltage is present.

#### 1481 ANALOG OUTPUT HOLDING AMPLIFIER (OHA)

Each 1481 provides 8 channels of analog output at a range of  $\pm 5$  volts. Each output channel maintains the voltage to within 5 mv per second.

### ANALOG SIGNAL CONDITIONERS

Used when standard signal ranges must be modified to meet specific external circuit requirements.

### ANALOG OUTPUT TERMINATION MODULES

Provides screw-down terminals or rugged multi-point cable connectors for terminating field wiring to customer equipment. Can be mounted to customer housing or in GA 1900 racks and enclosures.



**DIGITAL I/O**

The Digital Input Subsystem permits computer-directed real-time acquisition and transmission of digital equipment information in 16-bit parallel groups. The data word may consist of fields of binary-coded decimals, binary discrete bits, or any other pattern.

**1411 DIGITAL DIFFERENTIAL INPUT UNIT (DDI)**

Provides a digital input interface to the processor for high speed applications or for applications requiring high-level electrical isolation. Can be used as an input for pulse type or dc signals, as an interface with remote equipment having low-power logic signal outputs, or as a line receiver. Each DDI module has 16 digital input circuits and control logic.

**1431 DIGITAL INPUT RELAY RECEIVER (IRR)**

The 1431 provides a digital input signal interface to the processor for applications that require electrical isolation. Electrical isolation of processor input signals is provided through the use of relay coil input circuits. Each IRR module has 16 receivers and control logic.

**1413 GENERALIZED INPUT BUFFER (GIB)**

General-purpose input device used for parallel data communication between equipment using TTL-compatible circuitry. Can be used as a peripheral device input controller with paper tape readers, card readers, and other medium-speed peripherals. Each GIB module has 16 buffered inputs and control logic.

**1412 BUFFERED BIPOLAR POWER DRIVER (BPD)**

Provides the interface between the processor and peripheral of control equipment requiring high-speed driver signals from the processor. Suited for applications that require electrical isolation with nominal common mode voltage rejection and for use as a relay driver, lamp driver, or line driver. Each BPD has 18 output drivers.

**1432 BUFFERED CONTACT OUTPUT (BCO)**

Provides the interface between the processor and peripheral of control equipment requiring electrically isolated drive signals from the processor. Each BCO has 16 relay contact outputs and control logic.

**1414 GENERALIZED OUTPUT BUFFER (GOB)**

General-purpose output device used for parallel data communications between equipment using TTL-compatible circuitry. Can be used as a peripheral controller with devices as printers, card punches, paper tape punches, etc. Each GOB module has 16 buffered outputs and control logic.

**DIGITAL SIGNAL CONDITIONING**

Used when the standard ranges must be modified to meet specific circuit requirements.

**DIGITAL TERMINATION**

Provides screw-down terminals or rugged multi-point cable connectors for terminating field wiring to customer equipment. Can be mounted in customer housing or in GA 1900 racks and enclosures.

**COMMUNICATIONS I/O**

GA communications I/O units interface the computer to data transmission devices. These units are available for synchronous or asynchronous modes of operation, half or full duplex, in a wide variety of data rates.

**1551 BELL SYSTEM 103 DATA SET CONTROLLER (DS103)**

Provides a buffered interface between the processor and a Bell System Model 103 Data Set. Includes a serial-to-parallel/parallel-to-serial converter and a Bell System Interface. 110, 150 or 300 baud operation.

**1541 BELL SYSTEM 103/801 DATA SET AND AUTOMATIC CALLING UNIT (DS103/801)**

Provides a buffered interface between the processor and Bell System Model 103 Data Set with Model 801 Data Auxiliary Set (Automatic Calling Unit). Includes a serial-to-serial converter and a Bell System Interface. 110, 150 or 300 baud operation.

**1552 BELL SYSTEM 202 DATA SET CONTROLLER (DS202)**

Provides a buffered interface between the processor and a Bell System Model 202 Data Set. Includes a serial-to-parallel/parallel-to-serial converter and a Bell System Interface. 1050, 1200, or 1800 baud operation.

**1542 BELL SYSTEM 202/801 DATA SET AND AUTOMATIC CALLING UNIT CONTROLLER (DS202/801)**

Provides a buffered interface between the processor and a Bell System Model 202 Data Set with Model 801 Data Auxiliary Set (Automatic Calling Unit). Includes a serial-to-parallel/parallel-to-serial converter and Bell System Interface. Full duplex 1050, 1200, or 1800 baud operation.

**1553 BELL SYSTEM 201 DATA SET CONTROLLER (DS201)**

Synchronous operation. Includes a serial-to-parallel/parallel-to-serial converter and Bell System Interface. Operates up to 2400 baud, speed determined by modem clock.

**1554 BELL SYSTEM 201 DATA SET ADAPTER (DB201)**

Provides for the connection to Data Sets with synchronous transmitting capabilities of up to 9600 bps. Controller is double buffered. Includes hardware sync character direction and Bell Model 201 interface.



## DATA PROCESSING PERIPHERAL UNITS

**1311 CARD READER.** Serial reading of standard 80-column punched cards: 400 cards per minute.

**1313 CARD PUNCH.** Serial punching of standard 80-column punched cards: 100 cards per minute.

**1321 PAPER TAPE READER.** Reading of 1-inch, 8-channel paper tape: 400 cps. Data is read into the processor as a direct image of the holes in the tape.

**1322 PAPER TAPE PUNCH.** Punching of 1-inch, 8-channel paper tape, 75 cps. Data characters are punched as a direct image of the processor data output.

**1331 MAGNETIC TAPE UNIT.** Magnetic tape input/output: 20.0 kilo-bytes per second. Data recording and retrieval in IBM format, 9-track and/or 7-track. Handles reels with up to 2400 feet of storage. Tape speed is 25 ips. Up to eight tape drives can be connected to a system.

**1332 MAGNETIC TAPE UNIT.** Magnetic tape input/output: 30 kilo-bytes per second. Data recording and retrieval in IBM format, 9-track and/or 7-track. Handles reels with up to 2400 feet of storage. Tape speed is 37.5 ips. Up to eight tape drives can be connected to a system.

**1333 MAGNETIC TAPE UNIT.** Magnetic tape input/output: 60 kilo-bytes per second. Data recording and retrieval in IBM format, 9-track and/or 7-track. Handles reels with up to 2400 feet of storage. Tape speed is 75 ips. Up to eight tape drives can be connected to a system.

**1341 DISK STORAGE.** Movable head. Usable storage capacity is 2.56 million 16-bit words. Average access time: 45 milliseconds. Storage media: interchangeable disk pack consisting of 6 disks (IBM 1316 or equivalent). Up to eight 1341's can be connected to a system.

**1342 ROTATING MEMORY STORAGE.** Fixed head. Usable storage capacity is 32K, 64K, 128K or 256K 16-bit words. Average access time 8.5 milliseconds. One storage unit per controller.

**1343 DISK STORAGE.** Movable head. Usable storage is 10.24 million 16-bit words. Average access time: 45 milliseconds. Storage media: interchangeable disk pack consisting of 11 disks (IBM 2316 or equivalent). Up to four 1343's can be connected to a system.

**1344 DISK STORAGE.** Movable head. Usable storage capacity is 512K 16-bit words. Storage media: interchangeable disk cartridge (IBM 2315 or equivalent). Average access time: 60 milliseconds. Up to four 1344's can be connected to a system.

**1345 DISK STORAGE.** Low cost, movable head. Usable storage capacity is 512K words. Storage media: interchangeable disk cartridges (IBM 2315 or equivalent). Average access time: 160 milliseconds. One drive per controller.

**1353 LINE PRINTER.** Rotating drum line printer. Up to 600 lpm, full character set printing. 132 character buffer, 64 characters per print position. 8-channel VFO, variable from 3½ to 19½ inches in width.

**1361 PRINTER/KEYBOARD.** Printed output: 15.5 cps. Provides keyboard entry into the processor. (IBM Selectric.)

**1362 PRINTER/KEYBOARD (TTY).** Punched paper tape or printed output: 10 cps. Provides 10 cps data entry into the processor via keyboard or paper tape reader (ASR-33). Standard system console.

**1363 PRINTER/KEYBOARD (TTY).** High-reliability version of the 1362, with identical operating characteristics and functions, but with automatic send-receive. (ASR-35).

**1371 INCREMENTAL PLOTTER.** Recording of digital data in graphic form. 300 steps per second, 0.01 inches per step. Plotting area: 11 inches × 120 ft.





## THE TOTAL-SOLUTION COMPANY

General Automation offers industry a unique, total-solution approach to automation projects. Through us, automation customers receive the best possible fourth-generation products in combination with extensive services in high-technology automation. GA users obtain from only one source all the hardware, software, and technological capabilities to successfully complete their automation project.

### Computer-Based Automation Equipment

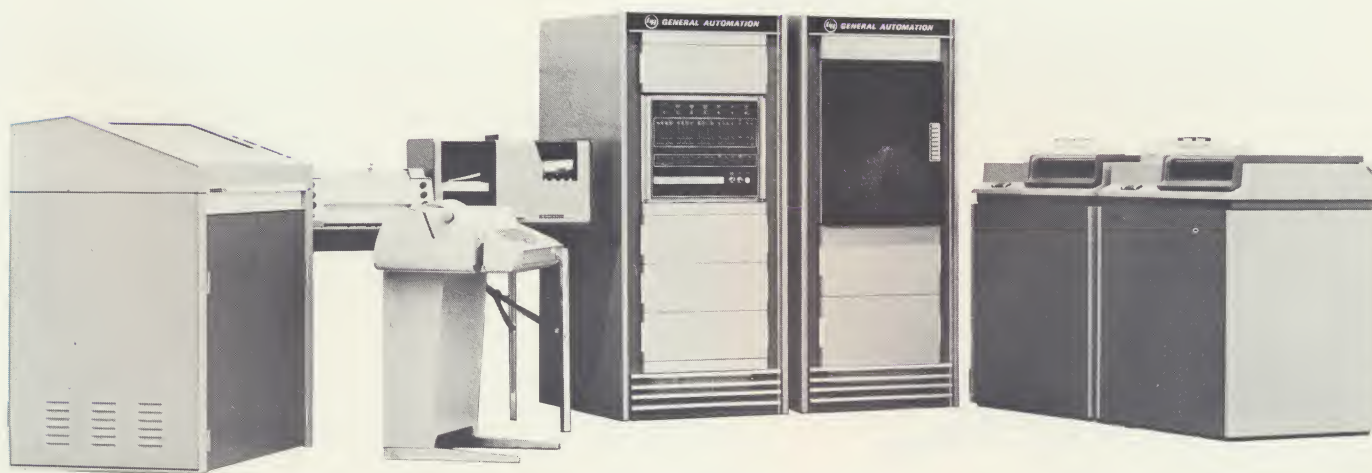
General Automation manufactures a comprehensive line of compatible, computer-based automation equipment. All GA products are designed around a modular-application theory, and may be used independently or as a total system, depending upon the size of the application. System interfacing, maintenance, and/or expansion is further simplified with wire-free, large-board construction, and part interchangeability. Field expansion can be implemented without interrupting existing computerized operations. The GA line of supervisory systems, worker computers, and plug-in, pre-engineered mini-controllers excel in high performance: versus-cost, quality, reliability, compact packaging, and hardware/software compatibility.

### Automation Services

General Automation Systems Analysts provide a thorough analysis of any situation or condition for automation; its Programming and Systems Engineering experts will implement a system to operate effectively at the lowest cost and shortest time possible. Higher productivity, increased profits, and fastest payback on minimum initial investment is thereby assured. These professionals offer the industrial automation market the highest computing skills available and the widest experience in applying these skills to automation projects. GA supplies the entire scope of services required to implement any project, from in-depth feasibility and systems analyses through program development, systems engineering, and customer training, to full "turn-key" project responsibility. Organized on a modular basis, GA services may be obtained individually or in combination to fit each customer's requirements.

### Sales and Field Service

GA users are strongly supported by a network of sales and service offices conveniently located throughout the U.S. and Europe. Each sales office is staffed with knowledgeable and highly experienced representatives. Backed up with the full resources of GA's automation expertise, these representatives can provide computer-based solutions to your automation project.





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